Nutrition Science: An Overview of American Genius

The 1975 W. O. Atwater Memorial Lecture

AGRICULTURAL RESEARCH SERVICE · U.S. DEPARTMENT OF AGRICULTURE

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The 1975 W. O. Atwater Memorial Lecture

Presented in cooperation with
the American Dietetic Association
at its 58th Annual Meeting
San Antonio, Texas
October 21, 1975

It is not my role to assess the system of incentives that makes possible this unprecedented phenomenon, but it is clear that the system we are privileged to enjoy at this Bicentennial time works. Let us examine the scientific base that has established the primacy of food and nutrition development in this Nation.

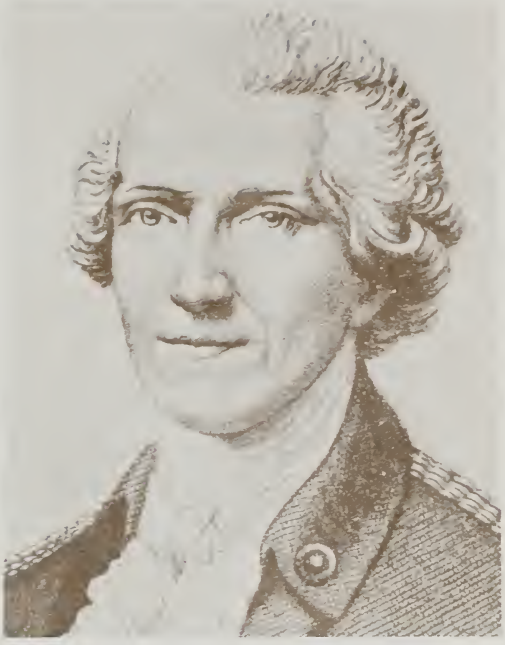
As prologue to the developments of this 200-year period, we must pay tribute to the enormous contributions that resulted from the genius of the American Indians who cultivated and gave to the world such important foods as corn or maize, potatoes, tomatoes, squash, many types of beans, cassava, turkey, cocoa, and numerous other foodstuffs. The introduction and use of such foods have sustained massive populations since the discovery of America, and influenced the course of world history.

Nutrition's Bicentennial

As we mark the Bicentennial of the United States, we also mark the Bicentennial of the science of nutrition. It was 200 years ago that Antoine-Laurent Lavoisier, Joseph Priestley, and Carl Scheele demonstrated the true nature of oxygen and the process of oxidation. Priestley, a nonconformist Unitarian minister whose chapel in Birmingham was burned by a Tory mob in 1791, migrated to America in 1794. In that same year, 1794, Lavoisier was beheaded on the guillotine in what was described by Charles Richet as the most criminal act of the French Revolution.

Lavoisier's widow, Marie, married American-born Benjamin Thompson (Count Rumford), a loyalist in the American Revolution who developed the

Antoine-Laurent Lavoisier and his wife, Marie. Portrait by Jacques David (1788). Lavoisier, from experimental data, concluded " . . . directly and without hypothesis that the conservation of animal heat in the body is due at least in greater part, to the transformation of *air pur* [oxygen] into *air fixe* [carbon dioxide] by the respiration . . ." establishing thereby the basis of modern metabolism.

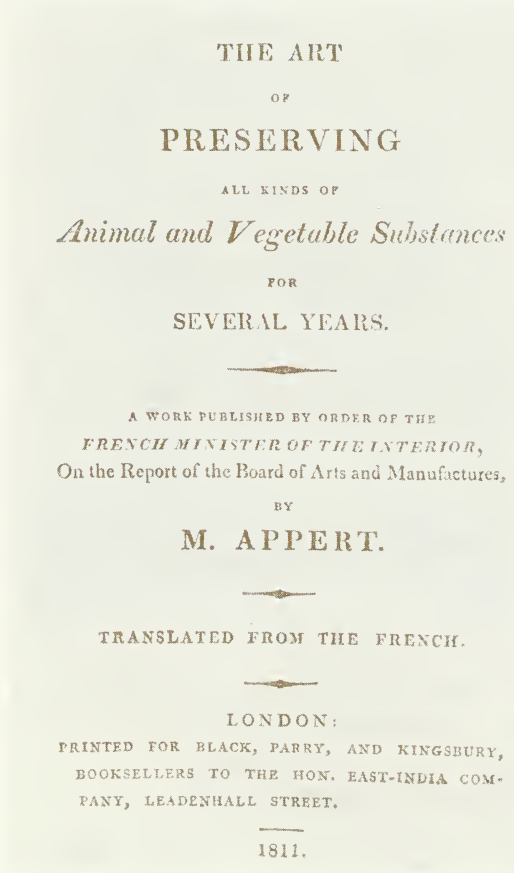


Benjamin Thompson (Count Rumford), American-born scientist-statesman, who in 1795 wrote concerning the "so-long-neglected" subject of "the science of nutrition."

newly independent country. The rare combination of exploration of basic theoretical scientific concepts and the concern for application in practical matters as exemplified by the works of these philosophers have been the hallmark of nutritional science in America.

Technological Beginnings

During the first century of our country and of nutritional science, ideas flowed rapidly between Europe and America. Following the French Revolution, Napoleon's extensive military campaigns demanded an improved food supply for his army. A monetary prize was offered for the design of a useful method



THE ART

OF

PRESERVING

ALL KINDS OF

Animal and Vegetable Substances

FOR

SEVERAL YEARS.

A WORK PUBLISHED BY ORDER OF THE

FRENCH MINISTER OF THE INTERIOR,

On the Report of the Board of Arts and Manufactures,

BY

M. APPERT.

TRANSLATED FROM THE FRENCH.

LONDON:

PRINTED FOR BLACK, PARRY, AND KINGSBURY, BOOKSELLERS TO THE HON. EAST-INDIA COMPANY, LEADENHALL STREET.

1811.

M. Appert's publication in French in 1810 of his method of preserving foodstuffs won for him the 12,000 franc prize offered by Napoleon and initiated the canning industry. His book was translated into English (title page shown here) in 1811.

for preserving foodstuffs, and, in 1810, M. Appert was awarded 12,000 francs by the Minister of the Interior, Count of the Empire, upon the recommendation of the Board of Arts and Manufacturers, which included the famous scientist Gay-Lussac. The prize-winning method of food preservation consisted of hermetical sealing of food in glass. Appert's treatise was translated and published in English in 1812.

Within a decade, William Underwood in Boston established a firm for the preservation of food by

Appert's process and, in 1839, both Underwood and Thomas Kensett gave up the use of glass bottles and introduced tin-plate containers . . . the revolution of canning had begun.

This innovation began the continuing series of technological advances in food in America: Gail Borden's invention of condensed milk and its success in supplying military needs during the Civil War; the refrigerated rail transport of meat by Swift; the quick-freezing of food by Clarence Birdseye and development of the necessary refrigerated distribution system for its commercialization; freeze drying of foods during World War II; to anticipate but a few subsequent examples of American genius.

Portion of an early (1858) flyer promoting milk condensed and preserved by the Gail Borden patented process. These products were successfully used as part of the rations of the Union Army during the Civil War (1861-1865).

New York, April 1, 1858.

THE NEW YORK CONDENSED MILK COMPANY,

Recently organized under the laws of this State, is prepared to furnish to the citizens of New York and Brooklyn,

At their Dwellings,

BORDEN'S CONDENSED MILK,

Patent Issued August 19th, 1856.

It is prepared at Burrville, Litchfield County, Conn., under the Supervision of Mr. BORDEN, the Patentee.

Nothing is added, and no valuable property is removed. The process simply consists in evaporating in vacuo, from the milk when PERFECTLY FRESH, nearly all its watery portion—about seventy-five gallons from every hundred gallons in its original state.

When properly sealed it will keep for years; *not sealed*, it remains good *under ice* for many days; combined with refined sugar in due proportions, it will keep without sealing or ice. When exposed to the influence of hot, damp weather, unsealed, and without ice it may continue sweet but little longer than common milk, and we, therefore, recommend it *as the article only for immediate use.*

Science and the Founding Fathers

Thomas Jefferson succeeded Benjamin Franklin as Minister to France. Jefferson has been termed: "The Scientific Scout for America." Indeed, these founding fathers set forth the philosophy, not only political, but scientific, which has determined America's greatness. Jefferson, in a letter from Paris, March 24, 1789, wrote to President Williard of Harvard:

> *. . . It is for such institutions as that over which you preside so worthily, Sir, to do justice to our country, its productions, and its genius. It is the work to which the young men, whom you are forming, should lay their hands. We have spent the prime of our lives in procuring them the precious blessing of liberty. Let them spend theirs in showing that it is the great parent of science and virtue; and that a nation will be great in both, always in proportion as it is free.*

Justus Von Liebig, a German scientist, oriented American agriculture and food and nutrition knowledge toward chemistry. The first American edition of Liebig's *"Organic Chemistry in Its Applications to Agriculture and Physiology"* was a reprint from the 1840 English edition translated by Playfair and contained additional notes and appendix by Professor John W. Webster of Harvard University (1841). Charles Browne notes that:

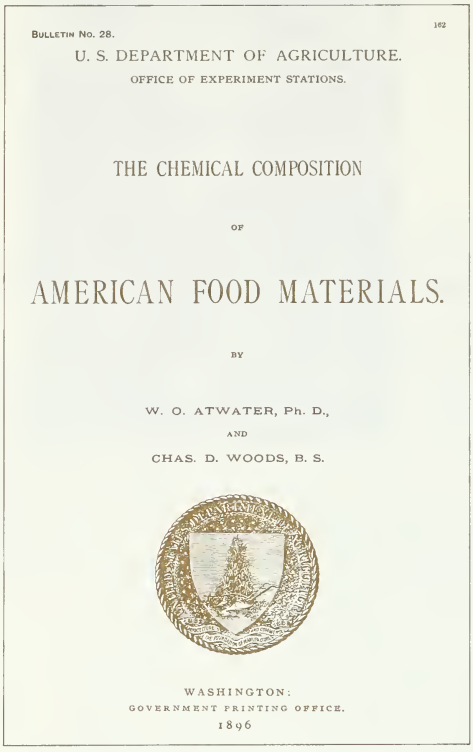
> *The influence of Liebig and his school upon agriculture was so overwhelmingly chemical that, for the next half-century after the publication of his book, chemistry was assumed to be the whole of science in agriculture. The sole importance of chemistry was so ingrained in the public*

Wilbur Olin Atwater (1844-1907), established the science of modern human nutrition in the United States, and directed the first nationwide program of human nutrition research, centered in the U.S. Department of Agriculture.

mind that Liebig's pupil, Charles W. Wetherill, was the first scientist to be appointed in the U.S. Department of Agriculture, in 1862. For many years after the establishment of agricultural experiment stations, in the creation of which Liebig's graduates played so important a part, it was tacitly assumed by State authorities that chemists were the only ones qualified to be the directors of these institutions. The chemical inspection of commercial fertilizers, another idea of Liebig, and the chief occupation of early experiment stations, had much to do with this attitude.

Atwater's Achievements

This influence led Wilbur O. Atwater to obtain his doctorate under Professor Samuel W. Johnson of Yale in 1869 with an interest in agricultural chemistry which took him to Leipzig and Berlin and subsequently to Carl Voit's laboratory in Munich. In 1875 he became Director of the newly established first State agricultural experiment station at Wesleyan University in Connecticut. His interests and efforts led to passage in 1887 of the Hatch Act establishing in the U.S. Department of Agriculture an Office of



Bulletin No. 28. 162

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS.

THE CHEMICAL COMPOSITION

OF

AMERICAN FOOD MATERIALS.

BY

W. O. ATWATER, Ph. D.,

AND

CHAS. D. WOODS, B. S.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1896

"The Chemical Composition of American Food Materials," compiled by Atwater and Bryant, served as the basic source of such information for some 44 years.

Experiment Stations of which Atwater became Chief, as well as Director of the new Storrs Experiment Station.

As Director of the Federal office, he conceived his mission to be "to bring the stations throughout the country together, to unify their work, and to put them into communication with the great world of science." He was adamant that the Office of Experiment Stations be kept out of politics and that it be placed upon "the highest and truest scientific level."

In 1891, he was appointed special agent in charge of nutrition programs and organized extensive food analyses, dietary studies, investigations of the energy requirements of man, research on digestibility of food, and studies of the economics of food.

With his coworker, Bryant, he compiled Bulletin No. 28 of the U.S. Office of Experiment Stations published in 1896 as *"The Chemical Composition of American Food Materials."* Revised in 1906, this bulletin remained the standard reference until the compilation of Chatfield and Adams' *"Proximate Composition of*

American Food Materials" was published in 1940 as U.S.D.A. Circular 549.

He studied nutrient losses resulting from processing and cooking. He made pioneering food consumption surveys in various geographic areas and among differing ethnic and socio-economic groups. He was particularly concerned with the problem of nutrition of the poor, the disadvantaged, institutionalized inmates, and those in other less fortunate nations.

Just at the end of the first century, the land grant colleges were established by the first Morrill Act of 1862. As America entered its second century, it was Wilbur O. Atwater who provided the remarkable leadership that enabled the implementation of Thomas Jefferson's appeal to President Williard of Harvard that "young men should be enabled to spend the prime of their lives in showing that this nation is the great parent of science and virtue."

Research in Human Metabolism

The emphasis upon energy requirements of man in the early years of this century stemmed from a close association between great American and German nutritional physiologists—Carl Voit, Max Rubner, Graham Lusk, Francis G. Benedict, W. O. Atwater, and others—who contributed to later improvements and simplifications of methodology. The basic units of energy values for carbohydrates, fats, and proteins derived during this period by Atwater remain the standards in use today, the familiar "Atwater units" of 9, 4, and 4 calories per gram for fat, carbohydrates, and protein.

Studies of energy relationships were extended to a wide range of animal species, from mouse to

elephant. Of great significance for production of animal foods was the work led by Professor H. P. Armsby, Director of the Pennsylvania Agricultural Experiment Station in cooperation with the U.S. Department of Agriculture and the Pennsylvania State College. Professor Armsby constructed and employed the only direct respiration calorimeter of sufficient size to use for cows, horses, and other large farm animals. Today, this historic instrument is the sole remaining direct calorimeter in the United States.

The American Chemical Society, the largest scientific professional chemical organization in the world, was conceived at a meeting in Northumberland, Pa., in 1874. The meeting was convened to mark the 100th anniversary of Joseph Priestley's discovery of oxygen. The Priestley Lectures at the Pennsylvania State College and the Priestley Medal of the American Chemical Society commemorate Joseph Priestley and indicate his influence upon the subsequent development of science in America.

Outside the mainstream of science stemming from the best of well-equipped laboratories, there began to emerge experimental, clinical research in human

The Priestly Medal of the American Chemical Society. Joseph Priestly, discoverer of oxygen (1774), migrated to the United States in 1794. The Priestly Medal of the Society commemorates his contributions.

William Beaumont and Alexis St. Martin—a patient with gastric fistula who served as Beaumont's subject in "Experiments and Observations on the Gastric Juice and the Physiology of Digestion" (1833).

nutrition in the middle of America's first 100 years. A youthful graduate of the University of Pennsylvania, John R. Young, presented in 1803 as his graduation thesis *"An Experimental Inquiry, Into the Principles of Nutrition, and the Digestive Process."* This was followed in 1833 by William Beaumont's *"Experiments and Observations on the Gastric Juice and the Physiology of Digestion."*

Beaumont's experiments were initiated while he was stationed at Michilimackinac, Michigan Territory, in 1822. They provide the foundation of knowledge on the nature of the fundamental process of digestion in man, just as initial insight into the nature of the digestive process was gained from the earlier studies of Spallanzani made on gastric juice obtained with a sponge

tied to a string and retrieved after swallowing.

During this first century, while there was wide awareness of the role of nutrition in the management of disease, and of the association between food and the cure or prevention of certain diseases now termed deficiency diseases—scurvy, pellagra, beriberi, and sprue—the state of scientific knowledge could hardly be termed either satisfactory or complete. The need for nitrogen in the form of protein and the presence of some specific amino acids in the protein had been established by Magendie in 1816.

In this country, it was in large measure the influence of the distinguished physiologist, Graham Lusk of Cornell, that placed the science of nutrition on a broader hard base, particularly as relates to metabolism of proteins and fat as well as the energy requirements in disease states.

Newer Knowledge of Nutrition

Eruption of interest in nutrition, experimental, basic, chemical, and clinical, followed upon the elaboration of the vitamin hypothesis stemming from the classical studies of Sir Frederick Gowland Hopkins. The astute analysis of Casimir Funk in 1911 consolidated the hypothesis and underscored it with a new term "vitamine."

This era, then, became that of *"The Newer Knowledge of Nutrition . . ."* as Professor E. V. McCollum entitled his book in 1918. Professor McCollum had come from the University of Wisconsin, a land grant institution, and now was in the School of Hygiene and Public Health at Johns Hopkins University. The preface to the first edition (1918) of his *"Newer Knowledge of Nutrition:*

Professor E. V. McCollum of Johns Hopkins University discovered "fat soluble Vitamin A," made numerous contributions to knowledge of nutrient requirements, and ushered in the era of the "Newer Knowledge of Nutrition."

The Use of Food for the Preservation of Health and Vitality" is of lasting interest:

> *The need for knowledge of nutrition was never greater than at the present time when so large a part of the energies of the people of Europe and America are absorbed in the activities of war. The demoralization of agriculture over wide areas, together with the shortage of tonnage for the transportation of food, have reduced the food supply of a number of nations to the danger point, and have cut off in great measure the opportunity for securing the variety which exists in normal times.*
>
> *The investigations of the last few years have, fortunately, led to great advancement in our knowledge of what constitutes an adequate diet. Such knowledge can, if rightly applied, greatly assist in enabling us to make use of our food supply in a manner which will avoid mistakes sufficiently serious to become reflected in a lowering of our standard of public health . . .*

Professor McCollum continues:

> *From the data discussed in the following pages it will be evident that the idea that freedom of choice, and variety of food sources for the diet will prevent any fault in the diet from becoming serious, is no longer tenable, especially if one is willing to admit the existence of many degrees of gradation of malnutrition, not recognizable except in their effects on the individual over a long period of time . . .*

The emphasis on the use of foods for the preservation of vitality and health and the "degrees of gradation of malnutrition, not recognizable except in their effects . . . over a long period of time" was greatly extended by Professor H. C. Sherman, Columbia University. Sherman and his colleagues conducted what may have been the first multigenerational studies of nutrition in experimental animals.

The Hunger Fighters

There was a diffusion of interest in nutrition in a wide number of colleges and universities, land grant institutions, departments of home economics, and in schools of medicine, particularly departments of pediatrics and of internal medicine, as well as biochemistry, physiology, and other of the basic sciences. This was the era of "the hunger fighters," those enormously imaginative and productive American scientists who contributed to the discovery, identification, isolation,

syntheses, and subsequent utilization of vitamin after vitamin in the conquest of deficiency diseases.

This era of American genius is studded with names and discoveries such as R. R. Williams and thiamin; Charles Glen King and vitamin C; E. V. McCollum and vitamins A and D and later trace elements; T. B. Osborne and Lafayette B. Mendel, vitamin A and protein; E. B. Hart and Conrad Elvehjem, iron, copper, niacin; Paul Gyorgy, riboflavin; Gyorgy, Lepkovsky, and Hogan, pyridoxine; and many others. It was highlighted by landmark discoveries of many physician-scientists such as Joseph Goldberger, William B. Castle, L. Emmett Holt, Jr., Randolph West, and Alfred Hess.

Pellagra and Poverty

Illustrative of the American genius in the field of public health nutrition is the story of Joseph Goldberger, who in 1914, as a career officer in the U.S. Public Health Service, was assigned the task of identifying the cause of pellagra in the South. This disease was thought by most persons to be of infectious origin. Victims suffered from the "3-D's"—dermatitis, diarrhea, and dementia; a number of mental institutions were primarily devoted to the care of pellagrins.

In his now classic epidemiological studies, Goldberger noted the association of the disease with poor diet—the "3-M's—meal, meat (fatback), molasses—and with poverty. One of the folk names for pellagra was "cornbread fever." This association of the disease throughout the world with Indian maize (corn), the cultivation of which was developed by the pre-Columbian Indians, makes it a peculiarly American phenomenon. Goldberger observed that well-fed persons did not

Joseph Goldberger, physician-scientist, wrote classic epidemiologic studies associating certain diseases with poor diets.

contract the disease. He reproduced the condition in convicts in Mississippi by feeding them a deficient pellagragenic diet. He, his wife, and 14 volunteer colleagues constituted a "filth squad" who ingested and were injected with various biological materials from patients, thus demonstrating the noninfectious nature of the pellagra. In orphanages, prisons, and in mental institutions, the therapeutic value of a good diet was demonstrated. He assayed foods in man for their pellagra-curative properties and in dogs for their pellagra-preventive action; canine blacktongue was utilized as the animal counterpart of pellagra.

In addition to remarkable epidemiological and experimental studies focusing upon the pellagra-preventive factor, Goldberger also examined the underlying reasons for the dietary deficiencies. He thoroughly analyzed the economic and social basis of pellagra. In his last public address on October 31, 1928 at a meeting of the American Dietetic Association, he stated:

. . . that the problem of pellagra is in main a problem of poverty. Education of the people will help; but improvement in basic economic conditions alone can be expected to heal this festering ulcer of our people. This, obviously, cannot be accomplished in a day, but that day will be hastened by the cooperative action of all whose vision enables them to see the great social and economic advantage to be derived from the eradication of the disease . . .

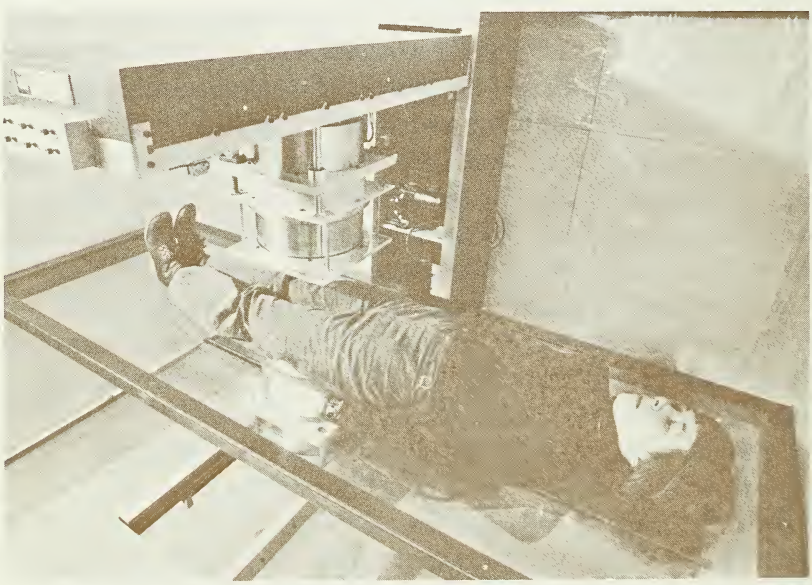
It is not possible here to dwell upon all the major contributions in clinical nutrition made by other ingenious American scholars—discoveries pertaining to ariboflavinosis; pyridoxine deficiency in man; sprue and other macrocytic anemias that respond to folic acid; pernicious anemia and vitamin B_{12} deficiency; protein deficiency; beriberi and other manifestations of thiamin deficiency; cirrhosis; nutrition in renal failure; and total parenteral nutrition. The beneficial contributions to infant feeding made by the cooperative efforts of American physicians, nutritionists, and members of the baby food industry, constitute other world-acclaimed achievements.

In the latter part of our second century, acceleration of research directed at the role of trace elements in human nutrition has extended our therapeutic and preventive concepts. These concepts have gone far beyond the initial successful control of endemic goiter with iodine, the use of iodized salt, or the control of dental decay with fluoridation of water supplies. Recognition of a syndrome in man resulting from human zinc deficiency, especially the dramatic response in growth and sexual maturation reported by the Vanderbilt-NAMRU-3 workers in 1962, has opened another broad front in the nutrition of man.

Growth of Nutrition Research in America

The impetus provided by these studies, plus the extensive earlier knowledge developed by nutritionists in agriculture concerning the need of animals for trace elements, has resulted in the establishment and support by the Agricultural Research Service, U.S. Department of Agriculture, of a unique nutrition laboratory. The USDA Human Nutrition Laboratory in Grand Forks, N. Dak., is devoted specifically to investigation of trace nutrients and their role in man.

And, as if complying with Thomas Jefferson's request "to do justice to our country, its productions and its



A whole body counter, employed by the ARS Human Nutrition Laboratory, Grand Forks, N.D., measures radiation from minerals found naturally in the body, as well as radiation from isotopes that are used to trace minerals in nutrition studies.

Dr. Harvey W. Wiley, father of the Pure Food and Drug Act, with members of the "Poison Squad," volunteers from the Department of Agriculture who served as subjects for human toxicologic research.

genius," institutions have been created within the public domain, within the academic community, in industry and government to determine how best to utilize our rapidly growing fundamental knowledge of nutrition, food, and agricultural science for the betterment of mankind.

In 1906, President Theodore Roosevelt signed the Pure Food and Drug Act, crusaded for by the Chief of the Bureau of Chemistry in the Department of Agriculture, Harvey W. Wiley. This tireless crusader effectively utilized a "poison squad" of 12 volunteers from the Department of Agriculture who served as

subjects for human toxicologic research. Dr. Wiley tells in his autobiography how he effectively gained the support of the canning industry in his campaign against irresponsible and dishonest adulterators of food.

At the turn of the century, an outstanding example of this support was that of Mr. H. J. Heinz. Concerned about the thin confidence of the public, and the industries' need to work in partnership with the Federal Regulatory Agency, Heinz sent his son Howard to Washington to offer support to Dr. Wiley and President Roosevelt.

Contributions by Industry

Instance after instance can be cited to illustrate the supportive role of our responsible American food companies individually and collectively, in applying their genius to utilize the science of nutrition in the best interest of mankind. Their contributions include iodinization of salt; enrichment of flour, cornmeal, cereals, bread and other cereal products; fortification of milk, including skim milk, with vitamins A and D; the nutritional improvement of beverages through addition of vitamin C; the development by the baby food industry of nutritious, safe, and convenient formulas and foodstuffs; the formulation of meal replacers and of other new products with careful attention to nutrient content; the modification of lipids in a variety of foodstuffs; the responsible design and control of special purpose foods; the development of foods with improved keeping qualities; attention to maintaining nutritional properties in plant-breeding programs; the institution of improved sanitation through wrapping, and packaging and cleaning prior to marketing—all these, and many

more achievements, illustrate the genius of America's scientifically-based food industry that provides the consumers with an abundant, wholesome, and nutritious food supply. And this has been accomplished at a fraction of American incomes—a fraction well below that found in Western Europe.

Standards of production and of livestock and crop management devised and jointly monitored by industry and government have given us an extraordinarily safe food supply. This has been noteworthy throughout the last half of our second century during a period in which we have experienced such rapid expansion and acceleration in the use of Liebig's chemical agents in agriculture and foods.

Medical, scientific, professional personnel, and organizations with a high sense of public responsibility give freely of their individual and collective resources, and their time and knowledge, to the many questions arising in the course of applying nutrition science.

A Wealth of Talent

To indicate the variety and competence of such groups, let us recall but a few: The American Dietetic Association; The American Medical Association, particularly its Council on Foods and Nutrition; nutrition committees of numerous State medical societies; The American Academy of Pediatrics and its Committee on Nutrition; The Institute of Food Technologists; The American Institute of Nutrition; The American Society of Clinical Nutrition; The American Public Health Association; The American Dental Association; The National Nutrition Consortium; The National Academy of Sciences-National Research Council, particularly its Food and

Nutrition Board, its Food Protection Committee, and its Agricultural Board.

These are but illustrative of the wealth of scientific talent drawn upon by governmental agencies and industry in considering questions related to foods and nutrition. And American genius has given much leadership in the founding and design of organizations of the United Nation's agencies, such as the Food and Agriculture Organization, the World Health Organization, the Pan American Health Organization, UNICEF, and UNESCO. All of these have major programs and concerns in the field of food and nutrition.

One observes with pride the continuity of humanitarian action in nutrition from the early days of World War I to UNICEF. This was due to the leadership of two great Americans: Herbert Hoover and Maurice Pate. When Mr. Hoover made his decisive personal commitment to obtain food for relief in Belgium, he recruited Maurice Pate to assist him. Mr. Pate later became the central figure in the organization of UNICEF as well as its first Executive Director.

The activities and philosophies of these two Americans undoubtedly influenced the subsequent concepts of international nutrition and bilateral programs of assistance. In fact, the interest of another group of American nutritionists closely identified with the programs of both UNICEF and WHO stimulated the formation of the Protein Advisory Group (PAG). The PAG has had a great influence upon the worldwide development of protein foodstuffs and infant and child-feeding preparations since 1955. This includes basic research and development required for the "protein revolution."

Allied in concept have been a variety of American food assistance programs during recent decades. U.S. AID and its predecessor agencies have provided enormous

supplies and expert guidance to improve nutrition around the world. The experiences gained, the successes achieved, and the failures or errors of such efforts are under active examination today by many responsible organizations. The World Food Conference in Rome in November 1974 provided stimulus for the acceleration of international programs to improve nutrition and for a closer liaison of international, governmental, nongovernmental, industrial, and voluntary agencies in these efforts.

An American Creation

A list of influences of great importance in improving nutrition must include the outstanding leadership by those uniquely American institutions—our nonprofit foundations. While it is possible to trace into ancient history the concept of support in perpetuity for charitable purposes, relief, ecclesiastical interest, an academy or library, the modern version of such support through the foundation is predominantly a 20th century American phenomenon.

The broad philanthropic foundation of today, with its profound impact upon society, dates from the gift of the English scientist, James Smithson, which created the Smithsonian Institution in 1846. The foundation picture in the early 20th century was dominated by the generously beneficial impact upon research and education of large foundations with broad purposes and flexibility of action. These were endowed by individuals or families who had attained great wealth in industry.

With imaginative leadership, The Rockefeller Foundation, jointed later by the Ford Foundation, established a series of international agricultural research institutes which today provide one of the few soundly conceived blueprints for mankind's future development and the meeting of food and nutrition needs.

The adaptation and utilization of scientific knowledge to bring about purposeful agricultural developments with a sharply focused target of meeting the food and nutrition needs of a nation or region occurred with great rapidity following the investment by The Rockefeller Foundation in Mexico during the earliest years of the 1940 decade. The names of J. George Harrar, Norman Borlaug, Elvin C. Stakman, Paul C. Mangelsdorf, and Richard Bradfield are indelibly inscribed in that cornerstone of the Green Revolution. Accomplishments in Mexico were followed by the founding of the International Rice Institute in the Philippines and the subsequent chain of similar important agricultural institutions in other parts of the world.

In the W. O. Atwater Memorial Lecture in 1974, Dr. Harrar confidently emphasized:

> *We can have a Green Revolution worldwide. Many of those who have written on this subject seemed to have failed to understand its true origins, meaning, and implication for the future. In fact, the Green Revolution, where it has been applied, has been a dramatic demonstration of the potential of combining all the elements of an efficient agricultural production system and translating them into greatly increased production figures. It has clearly demonstrated the fallacy of some of the earlier claims that many countries are doomed to hunger, disadvantage, and misery on a continuing basis because they are incapable of improving their most fundamental requirement, that of an adequate food supply and proper human diet. The success of the Green Revolution could be repeated again throughout much of the world where both the need and the opportunity exist to apply its principles and practices.*

J. George Harrar, President Emeritus, the Rockefeller Foundation, has been a principal strategist for national and international agricultural production. The research in wheat genetics by Norman Borlaug, (*right*) Nobel Peace Prize Laureate, greatly contributed to the alleviation of world hunger.

The Nutrition Foundation

Other foundations have in many ways contributed further to the development of knowledge of food and nutrition as well as to improved understanding of population control, a parallel requisite for future survival. Especially important, however, has been the leadership of those who, again in the early 1940's, established The Nutrition Foundation.

Leaders from the food and allied industries, universities, and research institutions, joined together in creating this Foundation, dedicated to the advancement of nutrition knowledge and to its effective application in improving the health and welfare of mankind.

A book-length history of The Nutrition Foundation written by its first full-time President and Scientific Director, Dr. Charles Glen King, will be published in 1976. The leadership of the advisors and supporters of this Foundation and their accomplishments provide another example of imaginative support of research, education, and the application of the science of nutrition. This leadership gives further assurance of a continuing

betterment of man's lot through American scientific and educational genius, in concert with the best in government and industry. The concept of organization and support represented by The Nutrition Foundation has now been adopted in England and Sweden, and, more recently, in Switzerland and France.

World Food and Nutrition Needs

There exists an enormous body of information, an increasing number of qualified agricultural, food and nutrition scientists, and an impressive technological development which should augur well for the future. But presently worldwide resources are woefully inadequate, qualitatively and quantitatively, to cope with the enormity of world food and nutrition needs.

In many parts of the world there is an insufficient number of qualified personnel. Our understanding of man and his culture, indeed, even his agriculture, is deficient for those regions which differ greatly from our own country. Yet the adaptation of acceptable technological improvements for use by developing peoples must be based upon such understanding. Failures of technology transfer often stem from this lack of understanding.

Within the United States we have overcome one handicap after another. As we have conquered the major classical deficiency diseases and so improved our productive potentials and enhanced our lifespan, we have come face to face with new nutritional considerations and new health problems. As we have attained new heights in medicine through diagnostic and therapeutic advances, we have often discovered that the new potential is limited either by our

failure to understand or to apply nutritional principles.

Individuals within the affluent society have been freed of the personal responsibility for the production and preservation of their own food. They have to a high degree lost an understanding of food and of the good diet. The decreased demands for physical work and energy expenditure are but a part of the changes in life style that alter the nutriture of industrialized man, yet his interest, or at least his comprehension, of these matters has lessened. This lessening is in large measure a result of the absence of sound nutrition teaching within the home and throughout our educational system from kindergarten through professional and graduate schools.

These losses in basic understanding of food and nutrition, and the insulation of the individual from direct contact with or control of his food, have created a fertile bed for growing the weeds of misinformation, distrust, and anxiety—the seeds of which are widely broadcast by sowers of differing kinds—profiteers, self-serving advocates, the uninformed, the misinformed, the charlatan, the political revolutionist, or even the scientist with limited understanding. Widespread understanding of sound information on food and nutrition is needed.

The Necessity for Nutrition Education

How can these needs be met? They can be met by incorporating nutrition information into all levels of formal education. The subject of nutrition, including basic knowledge concerning foods, should be a

curriculum requirement in all elementary schools and high schools.

All teachers or teachers in training should receive some education in nutrition; general courses in nutrition should be available in colleges and universities—courses so designed and taught as to provide proper guidance and information applicable to the life style and issues of the day.

A high priority should be given by colleges, universities, State and Federal educational departments for support of nutrition education of professionals and paraprofessionals, physicians, dietitians, public health nutritionists, dentists, nurses, veterinarians, social workers, physical education workers, and health educators.

Funds to support the establishment of faculty and resources for teaching nutrition in clinical, as well as preclinical, departments of medical schools must be made available. Such support should recognize the essentiality of combining teaching with research.

There should be expanded training and research in the areas of food and nutrition in the land grant universities and, particularly, enrichment of the resources for this in the 17 former Black land grant colleges established in 1890, and therefore known as "the 1890 schools."

The community and extension programs of our institutions of higher learning, colleges and universities, and our programs of medical care and social security, should include appropriate support for nutrition education personnel and activities.

High priority should be given to meeting the needs for expanding research, education, and training programs in food science, both nationally and in international development. Such programs should include appropriate

nutrition science, as well as an understanding of the production of food through utilization of both conventional agricultural products and unconventional sources of foodstuffs, new methods of production, and nutritionally-planned formulations.

The combined potential for food production inherent in agriculture and industry must be fully developed in order to attain maximum productivity of nutritious acceptable foods that are economically feasible for groups at various income levels. Only the full utilization of scientific knowledge derived from food science, agriculture, and nutrition can develop this potential.

Research Priorities

Knowledgeable and responsible planning groups are addressing themselves to these concerns. For example, the recent Working Conference on Research to Meet U.S. and World Food Needs assembled in Kansas City, July 9-11, 1975, under the sponsorship of the Agricultural Research Policy Advisory Committee, a land grant university, and the U.S. Department of Agriculture, to advise on research priorities.

This conference emphasized as the highest priority the need for further studies on human nutrient requirements and considerations involved in meeting them. There was a persistent emphasis on the need for greater support of education in the science of nutrition throughout these deliberations.

The World Food Conference had highlighted these same needs. The National Academy of Sciences is examining the research needs in the United States for developing and adapting the technology of food production to meet world nutritional requirements. This effort of the Academy is in response to a request from President Ford.

Personnel from academia, government, industry, and foundations are involved in these deliberations.

A larger pool of competent personnel must be developed to apply existing basic knowledge of food and nutrition to the maximum benefit of mankind. To make effective use of information under the different environmental, cultural, and economic systems, there must be generated an increased understanding of conditions and attitudes prevailing in regions where new technology is being introduced.

Such understanding is best developed by national personnel who have the opportunity for scientific education in relevant subject areas. Competent educated personnel must be available on a career basis to conduct field programs in developing societies. Funds and leadership may come from many sources. They must be shared by host countries and the community of industrialized, scientifically-advanced peoples. The priorities of governments must be reexamined and reset to assure requisite scientific and educational support for establishing food production at the required level. Furthermore, incentives and the needed resources must be provided in order to permit the implementation of effective food programs in the most needed areas.

A Shared Responsibility

In these major efforts, as well as in the continued development of new information concerning human nutritional requirements, the Agricultural Research Service of the U.S. Department of Agriculture has a major role to fulfill. Parallel roles must similarly by fulfilled by other Federal agencies: the State Department and U.S. AID; the Department of Health, Education and Welfare; the Department of Defense, and the

richer than Leonardo's, for it includes him and the Italian Renaissance; richer than Voltaire's, for it embraces all the French enlightenment and its ecumenical dissemination. If progress is real despite our whining, it is not because we are born any healthier, better or wiser than infants were in the past, but because we are born to a richer heritage, born on a higher level of that pedestal, which the accumulation of knowledge and art raises as the ground and support of our being. The heritage rises, and man rises in proportion as he receives it.

May society insure its own future with that support essential for us more fully to transmit our rich heritage so that man may rise in proportion as he receives it; and so that the third centennial of America and of the Science of Nutrition may fulfill the promise of our heritage.

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made extensive studies of maternal and infant nutrition. He is now finalizing a series of definitive papers on folic acid requirements of infants.

At present, Dr. Darby and two collaborators have in press a two volume work entitled *"Food: the Gift of Osiris,"* a history of food and food attitudes and taboos dating from the ancient Middle East. In 1976, the Nutrition Foundation will publish a biography of Wilbur O. Atwater, who has been described as the father of modern nutrition in this country—a man whose ideas are very much alive today.

Previous Lecturers and Cosponsoring Organizations

1968 Dr. Artturi I. Virtanen (deceased), Director, Biochemical Research Institute, Helsinki, Finland; Federation of American Societies for Experimental Biology, Atlantic City, N.J., April 16.

1969 Dr. Albert Szent-Gyorgi, Director, Institute for Muscle Research, Marine Biological Laboratory, Woods Hole, Mass.; American Chemical Society, New York, N.Y., September 10.

1970 Dr. Philip Handler, President, National Academy of Sciences, Washington, D.C.; Third International Congress of Food Science and Technology, Washington, D.C., August 11.

1971 Dr. Jean Mayer, Professor of Nutrition, Harvard University; The Second National Biological Congress, Miami Beach, Fla., October 24.

1973 Dr. Marina v. N. Whitman, Professor of Economics, University of Pittsburgh; The American Home Economics Association, Atlantic City, N.J., June 25.

1974 Dr. J. George Harrar, President Emeritus, The Rockefeller Foundation; The American Association for the Advancement of Science, San Francisco, Calif., February 28.